740. c. 25

Academies &c

A

DISCOURSE

ON THE

Invention and Improvements

OF THE

REFLECTING TELESCOPE.

DELIVERED AT THE
Anniverſary Meeting of the ROYAL SOCIETY,
November 30, 1777.

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By Sir JOHN PRINGLE, Baronet,
PRESIDENT.

PUBLISHED AT THEIR REQUEST.

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MDCCLXXVIII.

MVSEVM
BRITAN
NICVM

GENTLEMEN,

IT was with equal truth and modeſty obſerved by our moſt worthy brother the Reverend Dr. BRADLEY, in his celebrated Paper concerning the apparent motion of the fixed ſtars and the cauſes of that deception, *that the great exactneſs with which inſtruments are now conſtructed hath enabled the aſtronomers of the preſent age to diſcover ſeveral changes in the poſition of the heavenly bodies, which, by reaſon of their ſmallneſs, had eſcaped the notice of their predeceſſors*(a). And indeed it was upon this liberal principle, the embracing of every aſſiſtance which could be advantageous to their inſtitution, that this Society, from their foundation to this day, have cheriſhed the mechanical arts; nay, have often aſſociated thoſe artiſts that had invented or perfected inſtruments eminently conducive to the advancement of natural knowledge.

(a) Phil. Tranſ. vol. 45.

It is a merit of this kind, I would ſay a ſignal mechanical improvement, which your Council have thought proper at this time to diſtinguiſh; and they have accordingly empowered me to announce to you, on this day of your annual ſolemnity, that they have adjudged the prize-medal, founded on the benefaction of Sir GODFREY COPLEY, Baronet, to Mr. JOHN MUDGE of Plymouth, Fellow of this Society, on account of his valuable Paper *containing directions for making the beſt compoſition for the metals of reflecting teleſcopes, together with a deſcription of the proceſs for grinding, poliſhing, and giving the great ſpeculum the true parabolic form*(b). Nor do they doubt (conſcious as they are of their zeal for the honour of the Society, and of their attention to their duty) of obtaining your wonted approbation, when they ſhall have laid before you the reaſons which moved them to put this mark of diſtinction upon that communication, amidſt a number of others(c) very deſerving of praiſe.

But before I enter upon thoſe conſiderations, allow me briefly to recall to your memory ſome particulars concerning

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(b) Phil. Tranſ. vol. 67. part 1.

(c) The encouragement of *experimental* improvements, it may be obſerved, was the main object of the inſtitution of Sir GODFREY COPLEY's medal.

ing the invention of reflecting teleſcopes, the ſubſequent improvements of theſe inſtruments, and the ſtate in which Mr. MUDGE found them when he firſt ſet about working them to a greater perfection, than was attainable either by the methods which the artificers thought proper to divulge, or the directions that had been given by learned writers on that ſubject. Thus you will have under your view ſufficient materials to judge of the merits of his performance, and of the equity of your Council in decreeing theſe honours to him.

It muſt be acknowledged (ſays Dr. SMITH in his Complete Syſtem of Optics) *that Mr.* JAMES GREGORY *of Aberdeen was the firſt inventor of the reflecting teleſcope*; *but his conſtruction is quite different from Sir* ISAAC NEWTON's, *and not nearly ſo advantageous*(d).

But, with much deference to ſo reſpectable an author, and with all regard to the fame of GREGORY, let us not forget to do juſtice to MERSENNUS, by acknowledging him to be the man who is entitled to the credit of having entertained the *firſt* thought of a reflector. A teleſcope with *ſpecula* he certainly propoſed to the celebrated DESCARTES many years before GREGORY's invention, though

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(*d*) Remarks upon Art. 24.

indeed in a manner ſo very unſatisfactory, that DESCARTES, who had given particular attention to the improvement of the teleſcope, was ſo far from approving the propoſal, that he endeavoured to convince MERSENNUS of its fallacy[(e)]. Dr. SMITH, it appears, had never peruſed the two letters of DESCARTES to MERSENNUS which briefly touch on that ſubject.

Again, as to his aſſertion *that* GREGORY's *conſtruction was not nearly ſo advantageous as* NEWTON's, it may be accounted for from his having ſet it down early in the compoſition of his work, and forgetting to qualify it afterwards, when, before the publication, he had received pretty ſure information to the contrary. Or perhaps he was influenced by the example of Dr. BRADLEY, who had been a moſt ſucceſsful obſerver, and yet had always preferred the NEWTONIAN teleſcope to the other. But if long experience is allowed to be the final arbiter in ſuch matters, we muſt adjudge the ſuperiority to the latter, as that is now, and has been for ſeveral years paſt, the only inſtrument of the kind in requeſt.

(e) *Lettres de* DESCARTES, tome 2. printed at Paris in 1657, lett. 29. and 32. See this point diſcuſſed by two learned and candid authors, M. LE ROI in the *Encyclopedie*, under the article *Teleſcope*; and M. MONTUCLA in *Hiſt. des Mathem.* tome 2. p. 643.

GREGORY,

Gregory, a young man of an uncommon genius, was led to the invention, in ſeeking to correct two imperfections of the common teleſcope; the firſt was its too great length, which made it leſs manageable; the ſecond, the incorrectneſs of the image. Mathematicians had demonſtated, that a pencil of rays could not be collected in a ſingle point by a ſpherical lens; and alſo, that the image tranſmitted by ſuch a lens would be in ſome degree incurvated. Theſe inconveniences he believed would be obviated by ſubſtituting for the object-glaſs a metallic ſpeculum, of a parabolic figure, to receive the image, and to reflect it towards a ſmall ſpeculum of the ſame metal: this again was to return the image to an eye-glaſs placed behind the great ſpeculum, which for that purpoſe was to be perforated in its centre. This conſtruction he publiſhed in 1663, in his *Optica Promota*, a work which in every reſpect doth honour to the author. But as **Gregory**, as he himſelf declares, was endowed with no mechanical dexterity, nor could find any workman capable of realizing his invention, after ſome fruitleſs attempts in that way, he was obliged to give up the purſuit: and probably, had not ſome new diſcoveries been made in light and colours, a reflecting teleſcope would never more have been thought of, conſidering

dering the difficulty of the execution, and the ſmall advantages that could accrue from it, deduceable from the principles of optics that were then known.

But NEWTON, whoſe happy genius for experimental knowledge was equal to that for geometry, and who to theſe talents, in a ſupreme degree, joined patience and mechanical abilities; NEWTON, I ſay, thus accompliſhed, happily interpoſed, and ſaved this noble invention from well-nigh periſhing in its infant-ſtate. He likewiſe at an early period of life had applied himſelf to the improvement of the teleſcope, but imagining that GREGORY's *ſpecula* were neither very neceſſary, nor likely to be executed, he began with proſecuting the views of DESCARTES, who aimed at making a more perfect image of an object by grinding lenſes, not to the figure of a ſphere, but to that of one of the conic ſections. Now whilſt he was thus employed, three years after GREGORY's publication, he happened to take to the examination of the colours formed by a priſm, and having by the means of that ſimple inſtrument made the ever-memorable diſcovery of the *different refrangibility of the rays of light*, he then perceived that the errors of teleſcopes, ariſing from that cauſe alone, were ſome hundred times greater than ſuch as were occaſioned by the ſpheri-

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cal figure of lenſes. This circumſtance forced, as it were, NEWTON to fall into GREGORY's track, and to turn his thoughts to reflectors. *The different refrangibility of the rays of light* (ſays he, in a letter to Mr. OLDENBURG, ſecretary to this Society, dated in February, 1672) *made me take* reflections *into conſideration, and finding them regular, ſo that the angle of reflection of all ſorts of rays was equal to the angle of incidence, I underſtood, that by their mediation optic inſtruments might be brought to any degree of perfection imaginable, provided a reflecting ſubſtance could be found which would poliſh as finely as glaſs, and reflect as much light as glaſs tranſmits, and the art of communicating to it a parabolic figure be alſo obtained. . . . Amidſt theſe thoughts I was forced from Cambridge by the intervening plague, and it was more than two years before I proceeded further*(f).

It appears then, that if NEWTON was not the firſt inventor of the reflecting teleſcope, he was the main and effectual inventor. By the force of his admirable genius he fell upon this new property of light, and thereby found that all lenſes, of whatever figure, would be affected more or leſs with ſuch priſmatic aberrations of the rays as would be an inſuperable obſtacle to the perfection dering the difficulty of the execution, and the ſmall advantages that could accrue from it, deduceable from the principles of optics that were then known.

(f) Phil. Tranſ. n. 80.

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(f) Phil. Tranſ. n. 80.

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of a dioptric teleſcope. Here was (if I may uſe the ſimilitude) a diſorder inherent in the conſtitution of this inſtrument, which NEWTON, like a wiſe phyſician, penetrated into, and, by underſtanding the nature of the diſeaſe, was led to the remedy; one indeed that had been deviſed before, but for a different and a ſlighter ailment, and withal of ſuch difficult compoſition, that the contriver of it himſelf had not been able to prepare it.

It was towards the end of 1668, or in the beginning of the following year, when NEWTON being thus obliged to have recourſe to reflectors, and not relying on any artificer for making his *ſpecula*, ſet about the work himſelf, and early in the year 1672 completed two ſmall reflecting teleſcopes. In theſe he ground the great ſpeculum into a ſpherical concave; not but that he approved of the parabolic form propoſed by GREGORY, though he found himſelf unable to accompliſh it. In the letter that accompanied one of theſe inſtruments which he preſented to the Society, he writes, *that though he then deſpaired of performing that work* (to wit, the parabolic figure of the great ſpeculum) *by geometrical rules, yet he doubted not but that the thing might in ſome meaſure be accompliſhed by mechanical devices*(g).

(g) Phil. Tranſ. n. 81.

Not leſs did the difficulty appear to find a metallic ſubſtance that would be of a proper hardneſs, have the feweſt pores, and receive the ſmootheſt poliſh: a difficulty in truth which he deemed almoſt unſurmountable, when he conſidered that every irregularity in a reflecting ſurface would make the rays of light ſtray five or ſix times more out of their due courſe, than the like irregularities in a refracting one. In another letter, written ſoon after, he tells the ſecretary, *that he was very ſenſible that metal reflects leſs light than glaſs tranſmits*; . . . *but as he had found ſome metalline ſubſtances to be more ſtrongly reflective than others, to poliſh better, and to be freer from tarniſhing than others, ſo he hoped that there might in time be found out ſome ſubſtances much freer from theſe inconveniences than any yet known*(h). Meanwhile here was, as I ſaid, another ſtop; and the more diſcouraging, as it was not, like the former, to be removed by *mechanical devices*, nor even by any chemical principle that had been diſcovered. That want could only be ſupplied by making repeated trials; nay, I may ſay, as it were fortuitouſly. NEWTON therefore laboured till he found a compoſition that anſwered in ſome degree, and left it to thoſe who ſhould come after him to find a better. The induſtry of Mr. MUDGE has been aiding to that of Sir ISAAC NEWTON; and the happy aſſiſtant of that great man has been ſo candid as to acknowledge, that chance did ſave him much trouble, by furniſhing him with a metallic mixture, which he had reaſon to believe was fitter for the purpoſe than any that had been uſed before, either publiſhed, or concealed from the public.

(h) Phil. Tranſ. n. 82.

NEWTON having, with his teleſcope, communicated to the Society a full and ſatisfactory account of its conſtruction and performance, he received from your illuſtrious predeceſſors ſuch thanks as were due to ſo curious and valuable a preſent. And HUYGENS, one of the greateſt geniuſes of the age, and himſelf a diſtinguiſhed improver of the refractor, no ſooner was informed by Mr. OLDENBURG of the diſcovery than he wrote in anſwer, *that it was an admirable teleſcope; and that Mr.* NEWTON *had well conſidered the advantage which a concave ſpeculum had above convex glaſſes in collecting the parallel rays, which according to his own calculation was very great. Hence that Mr.* NEWTON *could give a far greater aperture to that ſpeculum than to an object glaſs of the ſame diſtance of focus, and conſequently much more magnify in his way than by an ordinary teleſcope. Beſides, that by the reflector he avoided an inconvenience inſeparable*

ble from object-glaſſes, which was the obliquity of both their ſurfaces, which vitiated the refraction of the rays that paſs towards the ſides of the glaſs, and did more hurt than men were aware of. Again, that by the mere reflection of the metalline ſpeculum there were not ſo many rays loſt as in glaſſes, which reflected a conſiderable quantity by each of their ſurfaces, and beſides intercepted many of them by the obſcurity of their matter. . . . . That the main buſineſs would be, to find a matter for this ſpeculum that would bear as good and even a poliſh as glaſs. Laſtly, he believed that Mr. NEWTON *had not been without conſidering the advantage which a parabolic ſpeculum would have above a ſpherical one in this conſtruction; but had deſpaired, as he himſelf had done, of working other ſurfaces than ſpherical ones with due exactneſs*(i). HUYGENS was not ſatisfied with thus expreſſing to the Society his high approbation of the late invention, but drew up a favourable account of the new teleſcope, which he cauſed to be publiſhed in the *Journal des Scavans*, of the year 1672, and by that channel it was ſoon known over Europe.

But how excellent ſoever the contrivance was; how well ſoever ſupported and announced to the public; yet whether it was that the artiſts were deterred by the difficulty

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(i) Phil. Tranſ. n. 81.

ficulty and labour of the work, or that the diſcoveries even of a NEWTON were not to be exempted from the general fatality attending great and uſeful inventions, *the making a ſlow and vexatious progreſs to the authors*; the fact is, that, excepting an unſucceſsful attempt which the Society made by employing an artificer to imitate the NEWTONIAN conſtruction, but upon a larger ſcale, and a diſguiſed GREGORIAN teleſcope, ſet up by CASSEGRAIN abroad as a rival to NEWTON'S, and that in theory only (for it never was put in execution by the author(k)) no reflector was heard of for nearly half a century after. But when that period was elapſed, a reflecting teleſcope was at laſt produced to the world of the NEWTONIAN conſtruction, which the venerable author, ere yet he had finiſhed his much diſtinguiſhed courſe, had the ſatisfaction to find executed in ſuch a manner, as left no room to fear that the invention would longer continue in obſcurity.

This memorable event was owing to the genius, dexterity, and application of a gentleman of this Society, Mr. HADLEY, the inventor of the reflecting quadrant, another moſt valuable inſtrument. The two teleſcopes which NEWTON had made were but ſix inches long,

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(k) Compare MONTUCLA, Hiſt. de Mathem. 2 t. p. 647.

long, were held in the hand for viewing objects, and in power were compared to a ſix-feet refractor; whereas HADLEY's was above five feet long, was provided with a well-contrived apparatus for managing it, and equalled in performance the famous aerial teleſcope of HUYGENS, of 123 feet in length. Excepting as to the manner of making the *ſpecula*, we have in the Tranſactions of 1723 a complete deſcription, with a figure, of this teleſcope, together with that of the machine for moving it; but, by a ſtrange omiſſion, NEWTON's name is not once mentioned in that Paper, ſo that any perſon not acquainted with the hiſtory of the invention, and reading that account only, might be apt to conclude that HADLEY had been the ſole contriver of it. But other Papers in the ſame volume, beſides the minutes of the Society, clearly ſhew that this worthy member meant nothing leſs than to arrogate to himſelf any merit in this performance that properly belonged to NEWTON.

It is known that the ſame celebrated artiſt, after finiſhing two teleſcopes of the NEWTONIAN conſtruction, accompliſhed a third in the GREGORIAN way; but, I ſhould judge, leſs ſucceſsfully, by Dr. SMITH's declaring ſo ſtrongly in favour of the other. Mr. HADLEY was not leſs communicative than he was ingenious, being ever ready to impart his lights to others; in particular we are informed, *that he ſpared no pains to inſtruct Mr.* MOLYNEUX *and the Reverend Dr.* BRADLEY; *and that when thoſe gentlemen had made a ſufficient proficiency in the art, being deſirous that theſe teleſcopes ſhould become more public, they liberally communicated to ſome of the principal inſtrument-makers of this city the knowledge they had acquired from him*(l). Now ſuch ſcholars, as it is eaſy to imagine, ſoon advanced beyond their maſters, and completed reflectors by other and better methods than what had been taught them.

Certain it is, at leaſt, that Mr. JAMES SHORT, as early as the year 1734, had ſignalized himſelf at Edinburgh by his work of this kind. The excellent MACLAURIN, my dear departed friend, wrote that year to Dr. JURIN, *that Mr.* SHORT, *who had begun with making glaſs* ſpecula, *was then applying himſelf to improve the metallic*; *and that by taking care of the figure he was enabled to give them larger apertures than others had done*; *and that upon the whole they ſurpaſſed in perfection all that he had ſeen of other workmen.* He added, *that Mr.* SHORT's *teleſcopes were all of the* GREGORIAN *conſtruction*; *and that he had much improved that excellent invention*(m). This character of excellence Mr. SHORT maintained to the laſt, and with the more facility as he had been well grounded both in the geometrical and philoſophical principles of optics, and upon the whole was a moſt intelligent perſon in whatever related to his profeſſion. It was ſuppoſed he had fallen upon a method of giving the parabolic figure to his great ſpeculum; a point of perfection that GREGORY and NEWTON had wiſhed for, but deſpaired of attaining; and that HADLEY had never, as far as we know, attempted, either in his NEWTONIAN or GREGORIAN teleſcope. Mr. SHORT, I am well informed, ſaid he had acquired that faculty, but never would tell by what peculiar means he effected it; ſo that the ſecret of working that configuration, whatever it was, as far as it then appeared, died with that ingenious artiſt.

(l) SMITH's Syſt. of Opt. b. 3. ch. 2. (m) Ibid. Rem. on Art. 489.

It is Mr. MUDGE therefore who hath truly realized the expectation of Sir ISAAC NEWTON, who, above an hundred years ago, preſaged that the public would one day poſſeſs a parabolic ſpeculum, *not accompliſhed by mathematical rules, but by mechanical devices.*

This was a *deſideratum*, but it was not the only want ſupplied by our worthy brother: he has taught us likewiſe a better compoſition of metals for the *ſpecula*, how to grind them better, and how to give them a finer poliſh; and this laſt part (namely the poliſh) he remarks was the moſt difficult and eſſential of the whole operation. In a word, I am of opinion, there is no optician in this great city (which hath been ſo long and ſo juſtly renowned for ingenious and dextrous makers of every kind of mathematical inſtruments) ſo partial to his own abilities as not to acknowledge, that however ſome parts of the mechanical proceſs now diſcloſed might have been known before by individuals of the profeſſion, yet that Mr. MUDGE hath opened to them all ſome new and important lights, and upon the whole hath greatly improved the art of making reflecting teleſcopes.

To enter into the detail of the *devices* (to uſe NEWTON's expreſſion) by which Mr. MUDGE hath arrived at the true parabolic figure, as well as at the other perfections of this inſtrument, would encroach too much on your time; and I may add, would not be altogether ſuitable to the preſent occaſion. I have laid before you the ſum of what he hath performed, and declared to you the opinion of your Council, that without his interpoſition the nicety of the art was in danger of being loſt; or at beſt of being kept in the hands of thoſe who were not likely to make it public. The character which Mr. MUDGE bears for integrity would leave us no room to doubt of his being himſelf perſuaded, that he hath in every point brought the great ſpeculum of reflecting teleſcopes to that degree of perfection which he profeſſes; but as authors and improvers, like parents and preceptors, can rarely diveſt themſelves of too partial a fondneſs for what is their own, or amended by them, it will be ſatisfactory for you to know, that ſome of our brethren, the moſt intelligent in theſe matters, have frequently diſcourſed with Mr. MUDGE upon this ſubject, have ſeen him at work upon the *ſpecula*; nay, have examined two reflecting teleſcopes (the one of 18 inches, the other of 22) completed by him; and that they are confident he hath by no means exaggerated either what he hath recovered to the body of arts, or what he hath added to it.

Need I now ſet forth the merit of aſcertaining and advancing the conſtruction of the reflecting teleſcope, to an Audience ſo well apprized of its value? To you who know that of all inventions there are none ſo juſtly entitled to our admiration as thoſe which have been fallen upon for enlarging the powers of viſion; and that the diſcovery of optical inſtruments may be eſteemed among the moſt noble as well as among the moſt uſeful gifts which the ſupreme Artiſt hath conferred on man? For all-admirable as the eye came out of the hands of Him who made it, yet no organ of the animal frame hath He permitted ſo much to be aſſiſted by human contrivance, not only for the uſes and comfort of common life, but for the advancement of natural ſcience; whether by giving form and proportion to the minute parts of bodies (as it were to the atoms of nature) imperceptible before; or by contracting ſpace, and, as by magic art, bringing to view the grander objects of the univerſe, whoſe immenſe diſtances had either diſguiſed their aſpect, or rendered them quite inviſible!

If PLINY, in regard to HIPPARCHUS, could extravagantly ſay, *Auſus rem Deo improbam annumerare poſteris ſtellas!* what would that pompous hiſtorian of nature have ſaid, had it been foretold him, that in the latter days a man would ariſe, who ſhould enable poſterity to enumerate more new ſtars than HIPPARCHUS had counted of the old; nay, who ſhould in a manner verify the vulgar notion of their being innumerable! who ſhould aſſign four Moons to Jupiter, and in our Moon (ſuppoſed by many to have a ſmooth and poliſhed ſurface) point out higher mountains than any here below! who ſhould in the Sun, the fountain of light, diſcover dark ſpots as broad as two quarters of the earth, and by theſe ſpots aſcertain his motion round his axis! who by the varying *phaſes* of the planets ſhould compoſe the ſhorteſt and plaineſt demonſtration of the truth of that ſyſtem, till then the greateſt of paradoxes, which ſuppoſed the earth and planets revolved about that luminary (n)? Yet theſe were but a part of the annunciations to the world of a ſingle perſon, of Galileo of unperiſhing memory! To him his contemporary, and rival in fame, Lord Bacon aſcribed the invention of the *perſpicilla* (for ſo they called at firſt the teleſcopes) and in a figurative ſtrain thus expreſſed himſelf concerning them: *With theſe* (perſpicilla) *which* Galileo *by a memorable effort of genius hath diſcovered, we are enabled, as with ſome ſmall ſailing veſſels, to open and keep up a nearer commerce with the ſtars* (o).

Nor did this celeſtial commerce ceaſe with the acquiſitions of Galileo, but hath been extending ever ſince the time that that great man firſt turned his glaſſes to the heavens. The famous Kepler, on the firſt notice, embraced the diſcovery, and in 1611, the year following the *Sidereus Nuncius* of Galileo, publiſhed a treatiſe of dioptrics, geometrically explaining the performance of the *perſpicilla*, and propoſing ſome proper improvements of them. Then came SNELLIUS, DESCARTES, and other celebrated geometricians abroad, who applied themſelves to optics, and ſucceſsfully cultivated that fruitful branch of ſcience. But whilſt at that period, in different parts of Europe, men of the firſt rank in mathematical ſtudies ſeemed to vie with each other in promoting not only the theory of viſion, but the mechanical practice of the inſtruments appertaining to it, and particularly the teleſcope; how did it happen, that in this country, in the laſt century, which had ſo auſpiciouſly begun with the lights derived from Lord BACON and Dr. HARVEY, we ſhould afterwards find few traces of any attempt in that way earlier than the eſtabliſhment of this Society? Of this pauſe in the courſe of your philoſophical diſcoveries, the diſtracted ſtate of theſe kingdoms, under a long civil war, was indubitably the occaſion. For no ſooner had we ſheathed the bloody ſword and diſplayed the peaceful olive, than arts and ſciences again ſprang forth, and with ſo much vigour, that the advancement made in theſe lands, ſince that epoch, in optics alone, may be conſidered as one of the nobleſt exertions of the human genius. Not to contend for a general ſuperiority in the publications here on that ſubject ſince the time that GREGORY entered firſt into that grand career, to ſilence all competition I need but mention the *Theory of Light and Colours*; a piece ſo excellent for invention, for judgment in conducting experiments, and for drawing the proper concluſions from them, that had it been NEWTON's ſingle work it would not only have done laſting honour to himſelf, but to the country that gave him birth. And as to the inſtruments, which of them, let me aſk, hath not been either found out, or ſignally improved among you? Or what nation is there that hath embraced the arts, and doth not value itſelf on poſſeſſing every piece of this kind of Britiſh workmanſhip. The reflecting teleſcope I may call wholly yours, both as to the original contrivance and every ſtep of its advancement: nay, from its revival by Mr. HADLEY to this day, a ſpace of nearly threeſcore years, we have heard of no artiſt, out of this iſland, who hath been able tolerably to copy, much leſs to add to this ſplendid invention.

(n) Galilei Sidereus Nuncius, *ſparſim.*

(o) Quæ (perſpicilla) memorabili conatu adinvenit Galileus, &c. Nov. Organ. l. 2. aphor. 39.

What acknowledgements then, GENTLEMEN, do we not owe to our worthy brother, who for above twenty years paſt, in the uncertain intervals of a toilſome and anxious profeſſion, hath unbent his mind, not in the periſhing recreations of the world; but in inveſtigating, with unremitting diligence, what had been done but concealed by others, and in making many ſucceſsful experiments

riments towards perfecting this inimitable inſtrument! A liberal account of theſe leiſure hours he hath laid before you in his inſtructive Paper: a communication, I am perſuaded, that will not only preſerve but ſignalize his name in your records, among the very intelligent and ingenuous promoters of the great ends of your inſtitution.

MVSEVM
BRITAN
NICVM